(3) You may also use a nominal value of absolute pressure based on an alarm set point, a pressure regulator set point, or good engineering judgment.

(4) Set $x_{H2O[emission]meas}$ equal to that of the measured upstream humidity condition if it is lower than the dryer saturation conditions.

(c) For a corresponding concentration or flow measurement where you did not remove water, you may determine the amount of initial water by any of the following:

(1) Use any of the techniques described in paragraph (b) of this section.

(2) If the measurement comes from raw exhaust, you may determine the amount of water based on intake-air humidity, plus a chemical balance of fuel, intake air and exhaust as described in §1065.655.

(3) If the measurement comes from diluted exhaust, you may determine the amount of water based on intake-air humidity, dilution air humidity, and a chemical balance of fuel, intake air, and exhaust as described in §1065.655.

(d) Perform a removed water correction to the concentration measurement using the following equation:

$$x = x_{[emission]meas} \cdot \left[\frac{1 - x_{H2Oexh}}{1 - x_{H2O[emission]meas}} \right] \qquad \text{Eq. 1065.659-1}$$

Example:

x_{COmeas} = 29.0 µmol/mol
$x_{H2OCOmeas}$ = 8.601 mmol/mol = 0.008601 mol/mol
x_{H2Oexh} = 34.04 mmol/mol = 0.03404 mol/mol

$$x_{CO} = 29.0 \cdot \left[\frac{1 - 0.03404}{1 - 0.008601} \right]$$

x_{CO} = 28.3 µmol/mol

[73 FR 37335, June 30, 2008]

§ 1065.660 THC, NMHC, and CH₄ determination.

(a) *THC determination and THC/CH₄ initial contamination corrections.* (1) If we require you to determine THC emissions, calculate $x_{THC[THC-FID]cor}$ using the initial THC contamination concentration $x_{THC[THC-FID]init}$ from §1065.520 as follows:

$$x_{THC[THC\text{-}FID]cor} = x_{THC[THC\text{-}FID]uncor} - x_{THC[THC\text{-}FID]\,init} \qquad \text{Eq. 1065.660-1}$$

Example:

$x_{THCuncor}$ = 150.3 µmol/mol
$x_{THCinit}$ = 1.1 µmol/mol
x_{THCcor} = 150.3 − 1.1
x_{THCcor} = 149.2 µmol/mol

(2) For the NMHC determination described in paragraph (b) of this section, correct $x_{THC[THC-FID]}$ for initial HC contamination using Eq. 1065.660–1. You may correct $x_{THC[NMC-FID]}$ for initial contamination of the CH₄ sample train using Eq. 1065.660–1, substituting in CH₄ concentrations for THC.

(3) For the CH₄ determination described in paragraph (c) of this section, you may correct $x_{THC[NMC-FID]}$ for initial contamination of the CH₄ sample train using Eq. 1065.660–1, substituting in CH₄ concentrations for THC.

(b) *NMHC determination.* Use one of the following to determine NMHC concentration, x_{NMHC}:

(1) If you do not measure CH₄, you may determine NMHC concentrations as described in §1065.650(c)(1)(vi).

(2) For nonmethane cutters, calculate x_{NMHC} using the nonmethane cutter's penetration fractions (*PF*) of CH₄ and C₂H₆ from §1065.365, and using the HC contamination and dry-to-wet corrected THC concentration $x_{THC[THC-FID]cor}$ as determined in paragraph (a) of this section.

(i) Use the following equation for penetration fractions determined using an NMC configuration as outlined in § 1065.365(d):

$$x_{\text{NMHC}} = \frac{x_{\text{THC[THC-FID]cor}} - x_{\text{THC[NMC-FID]cor}} \cdot RF_{\text{CH4[THC-FID]}}}{1 - RFPF_{\text{C2H6[NMC-FID]}} \cdot RF_{\text{CH4[THC-FID]}}}$$

Eq. 1065.660-2

Where:

x_{NMHC} = concentration of NMHC.

$x_{\text{THC[THC–FID]cor}}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID during sampling while bypassing the NMC.

$x_{\text{THC[NMC–FID]cor}}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the NMC FID during sampling through the NMC.

$RF_{\text{CH4[THC–FID]}}$ = response factor of THC FID to CH_4, according to § 1065.360(d).

$RFPF_{\text{C2H6[NMC–FID]}}$ = nonmethane cutter combined ethane response factor and penetration fraction, according to § 1065.365(d).

Example:

$x_{\text{THC[THC–FID]cor}}$ = 150.3 µmol/mol

$x_{\text{THC[NMC–FID]cor}}$ = 20.5 µmol/mol

$RFPF_{\text{C2H6[NMC–FID]}}$ = 0.019

$RF_{\text{CH4[THC–FID]}}$ = 1.05

$$x_{\text{NMHC}} = \frac{150.3 - 20.5 \cdot 1.05}{1 - 0.019 \cdot 1.05}$$

x_{NMHC} = 131.4 µmol/mol

(ii) For penetration fractions determined using an NMC configuration as outlined in section § 1065.365(e), use the following equation:

$$x_{\text{NMHC}} = \frac{x_{\text{THC[THC-FID]cor}} \cdot PF_{\text{CH4[NMC-FID]}} - x_{\text{THC[NMC-FID]cor}}}{PF_{\text{CH4[NMC-FID]}} - PF_{\text{C2H6[NMC-FID]}}}$$

Eq. 1065.660-3

Where:

x_{NMHC} = concentration of NMHC.

$x_{\text{THC[THC–FID]cor}}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID during sampling while bypassing the NMC.

$PF_{\text{CH4[NMC–FID]}}$ = nonmethane cutter CH_4 penetration fraction, according to § 1065.365(e).

$x_{\text{THC[NMC–FID]cor}}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the THC FID during sampling through the NMC.

$PF_{\text{C2H6[NMC–FID]}}$ = nonmethane cutter ethane penetration fraction, according to § 1065.365(e).

Example:

$x_{\text{THC[THC–FID]cor}}$ = 150.3 µmol/mol

$PF_{\text{CH4[NMC–FID]}}$ = 0.990

$x_{\text{THC[NMC–FID]cor}}$ = 20.5 µmol/mol

$PF_{\text{C2H6[NMC–FID]}}$ = 0.020

$$x_{\text{NMHC}} = \frac{150.3 \cdot 0.990 - 20.5}{0.990 - 0.020}$$

x_{NMHC} = 132.3 µmol/mol

(iii) For penetration fractions determined using an NMC configuration as outlined in section § 1065.365(f), use the following equation:

$$x_{\text{NMHC}} = \frac{x_{\text{THC[THC-FID]cor}} \cdot PF_{\text{CH4[NMC-FID]}} - x_{\text{THC[NMC-FID]cor}} \cdot RF_{\text{CH4[THC-FID]}}}{PF_{\text{CH4[NMC-FID]}} - RFPF_{\text{C2H6[NMC-FID]}} \cdot RF_{\text{CH4[THC-FID]}}}$$

Eq. 1065.660-4

Where:

x_{NMHC} = concentration of NMHC.

$x_{\text{THC[THC–FID]cor}}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID during sampling while bypassing the NMC.

$PF_{\text{CH4[NMC–FID]}}$ = nonmethane cutter CH_4 penetration fraction, according to § 1065.365(f).

$x_{THC[NMC–FID]cor}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the THC FID during sampling through the NMC.

$RFPF_{C2H6[NMC–FID]}$ = nonmethane cutter CH$_4$ combined ethane response factor and penetration fraction, according to §1065.365(f).

$RF_{CH4[THC–FID]}$ = response factor of THC FID to CH$_4$, according to §1065.360(d).

Example:

$x_{THC[THC–FID]cor}$ = 150.3 µmol/mol
$PF_{CH4[NMC–FID]}$ = 0.990
$x_{THC[NMC–FID]cor}$ = 20.5 µmol/mol
$RFPF_{C2H6[NMC–FID]}$ = 0.019
$RF_{CH4[THC–FID]}$ = 0.980

$$x_{NMHC} = \frac{150.3 \cdot 0.990 - 20.5 \cdot 0.980}{0.990 - 0.019 \cdot 0.980}$$

x_{NMHC} = 132.5 µmol/mol

(3) For a gas chromatograph, calculate x_{NMHC} using the THC analyzer's response factor (RF) for CH$_4$, from §1065.360, and the HC contamination and dry-to-wet corrected initial THC concentration $x_{THC[THC–FID]cor}$ as determined in paragraph (a) of this section as follows:

$$x_{NMHC} = x_{THC[THC-FID]cor} - RF_{CH4[THC-FID]} \cdot x_{CH4} \qquad \text{Eq. 1065.660-5}$$

Where:

x_{NMHC} = concentration of NMHC.

$x_{THC[THC-FID]cor}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID.

x_{CH4} = concentration of CH$_4$, HC contamination (optional) and dry-to-wet corrected, as measured by the gas chromatograph FID.

$RF_{CH4[THC-FID]}$ = response factor of THC-FID to CH$_4$.

Example:

$x_{THC[THC-FID][cor}$ = 145.6 µmol/mol
$RF_{CH4[THC-FID]}$ = 0.970
x_{CH4} = 18.9 µmol/mol
x_{NMHC} = 145.6 − 0.970 · 18.9

x_{NMHC} = 127.3 µmol/mol

(c) *CH$_4$ determination.* Use one of the following methods to determine CH$_4$ concentration, x_{CH4}:

(1) For nonmethane cutters, calculate x_{CH4} using the nonmethane cutter's penetration fractions (*PF*) of CH$_4$ and C$_2$H$_6$ from §1065.365, using the dry-to-wet corrected CH$_4$ concentration $x_{THC[NMC–FID]cor}$ as determined in paragraph (a) of this section and optionally using the CH$_4$ contamination correction under paragraph (a) of this section.

(i) Use the following equation for penetration fractions determined using an NMC configuration as outlined in §1065.365(d):

$$x_{CH4} = \frac{x_{THC[NMC-FID]cor} - x_{THC[THC-FID]cor} \cdot RFPF_{C2H6[NMC-FID]}}{1 - RFPF_{C2H6[NMC-FID]} \cdot RF_{CH4[THC-FID]}} \qquad \text{Eq. 1065.660-6}$$

Where:

x_{CH4} = concentration of CH$_4$.

$x_{THC[NMC–FID]cor}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the

NMC FID during sampling through the NMC.

$x_{THC[THC–FID]cor}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC

FID during sampling while bypassing the NMC.

$RFPF_{C2H6[NMC-FID]}$ = the combined ethane response factor and penetration fraction of the nonmethane cutter, according to §1065.365(d).

$RF_{CH4[THC-FID]}$ = response factor of THC FID to CH₄, according to §1065.360(d).

Example:

$x_{THC[NMC-FID]cor}$ = 10.4 µmol/mol

$x_{THC[THC-FID]cor}$ = 150.3 µmol/mol

$RFPF_{C2H6[NMC-FID]}$ = 0.019

$RF_{CH4[THC-FID]}$ = 1.05

$$x_{CH4} = \frac{10.4 - 150.3 \cdot 0.019}{1 - 0.019 \cdot 1.05}$$

x_{CH4} = 7.69 µmol/mol

(ii) For penetration fractions determined using an NMC configuration as outlined in §1065.365(e), use the following equation:

$$x_{CH4} = \frac{x_{THC[NMC\text{-}FID]cor} - x_{THC[THC\text{-}FID]cor} \cdot PF_{C2H6[NMC\text{-}FID]}}{RF_{CH4[THC\text{-}FID]} \cdot \left(PF_{CH4[NMC\text{-}FID]} - PF_{C2H6[NMC\text{-}FID]} \right)} \qquad \text{Eq. 1065.660-7}$$

Where:

x_{CH4} = concentration of CH₄.

$x_{THC[NMC-FID]cor}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the NMC FID during sampling through the NMC.

$x_{THC[THC-FID]cor}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID during sampling while bypassing the NMC.

$PF_{C2H6[NMC-FID]}$ = nonmethane cutter ethane penetration fraction, according to §1065.365(e).

$RF_{CH4[THC-FID]}$ = response factor of THC FID to CH₄, according to §1065.360(d).

$PF_{CH4[NMC-FID]}$ = nonmethane cutter CH₄ penetration fraction, according to §1065.365(e).

Example:

$x_{THC[NMC-FID]cor}$ = 10.4 µmol/mol

$x_{THC[THC-FID]cor}$ = 150.3 µmol/mol

$PF_{C2H6[NMC-FID]}$ = 0.020

$RF_{CH4[THC-FID]}$ = 1.05

$PF_{CH4[NMC-FID]}$ = 0.990

$$x_{CH4} = \frac{10.4 - 150.3 \cdot 0.020}{1.05 \cdot (0.990 - 0.020)}$$

x_{CH4} = 7.25 µmol/mol

(iii) For penetration fractions determined using an NMC configuration as outlined in §1065.365(f), use the following equation:

$$x_{CH4} = \frac{x_{THC[NMC\text{-}FID]cor} - x_{THC[THC\text{-}FID]cor} \cdot RFPF_{C2H6[NMC\text{-}FID]}}{PF_{CH4[NMC\text{-}FID]} - RFPF_{C2H6[NMC\text{-}FID]} \cdot RF_{CH4[THC\text{-}FID]}} \qquad \text{Eq. 1065.660-8}$$

Where:

x_{CH4} = concentration of CH₄.

$x_{THC[NMC-FID]cor}$ = concentration of THC, HC contamination (optional) and dry-to-wet corrected, as measured by the NMC FID during sampling through the NMC.

$x_{THC[THC-FID]cor}$ = concentration of THC, HC contamination and dry-to-wet corrected, as measured by the THC FID during sampling while bypassing the NMC.

$RFPF_{C2H6[NMC-FID]}$ = the combined ethane response factor and penetration fraction of the nonmethane cutter, according to §1065.365(f).

$PF_{CH4[NMC-FID]}$ = nonmethane cutter CH₄ penetration fraction, according to §1065.365(f).

$RF_{CH4[THC-FID]}$ = response factor of THC FID to CH₄, according to §1065.360(d).

Example:

$x_{THC[NMC-FID]cor}$ = 10.4 µmol/mol

$x_{THC[THC-FID]cor}$ = 150.3 µmol/mol

$RFPF_{C2H6[NMC-FID]} = 0.019$

$PF_{CH4[NMC-FID]} = 0.990$

$RF_{CH4[THC-FID]} = 1.05$

$$x_{CH4} = \frac{10.4 - 150.3 \cdot 0.019}{0.990 - 0.019 \cdot 1.05}$$

x_{CH4} = 7.78 µmol/mol

(2) For a gas chromatograph, x_{CH4} is the actual dry-to-wet corrected CH_4 concentration as measured by the analyzer.

[73 FR 37336, June 30, 2008, as amended at 73 FR 59339, Oct. 8, 2008; 74 FR 56516, Oct. 30, 2009; 75 FR 68464, Nov. 8, 2010]

§ 1065.665 THCE and NMHCE determination.

(a) If you measured an oxygenated hydrocarbon's mass concentration, first calculate its molar concentration in the exhaust sample stream from which the sample was taken (raw or diluted exhaust), and convert this into a C_1-equivalent molar concentration. Add these C_1-equivalent molar concentrations to the molar concentration of NOTHC. The result is the molar concentration of THCE. Calculate THCE concentration using the following equations, noting that equation 1065.665–3 is only required if you need to convert your OHC concentration from mass to moles:

$$x_{THCE} = x_{NOTHC} + \sum_{i=1}^{N}\left(x_{OHCi} - x_{OHCi\text{-init}}\right) \qquad \text{Eq. 1065.665-1}$$

$$x_{NOTHC} = x_{THC[THC-FID]cor} - \sum_{i=1}^{N}\left(x_{OHCi} \cdot RF_{OHCi[THC-FID]}\right) \qquad \text{Eq. 1065.665-2}$$

$$x_{OHCi} = \frac{\dfrac{m_{dexhOHCi}}{M_{OHCi}}}{\dfrac{m_{dexh}}{M_{dexh}}} = \frac{n_{dexhOHCi}}{n_{dexh}} \qquad \text{Eq. 1065.665-3}$$

Where:

x_{THCE} = The C_1-equivalent sum of the concentration of carbon mass contributions of non-oxygenated hydrocarbons, alcohols, and aldehydes.

x_{NOTHC} = The C_1-equivalent sum of the concentration of nonoxygenated THC.

x_{OHCi} = The C_1-equivalent concentration of oxygenated species i in diluted exhaust, not corrected for initial contamination.

$x_{OHCi\text{-init}}$ = The C_1-equivalent concentration of the initial system contamination (optional) of oxygenated species i, dry-to-wet corrected.

$x_{THC[THC-FID]cor}$ = The C_1-equivalent response to NOTHC and all OHC in diluted exhaust, HC contamination and dry-to-wet corrected, as measured by the THC-FID.

$RF_{OHCi[THC-FID]}$ = The response factor of the FID to species i relative to propane on a C_1-equivalent basis.

$C^{\#}$ = The mean number of carbon atoms in the particular compound.

M_{dexh} = The molar mass of diluted exhaust as determined in §1065.340.

$m_{dexhOHCi}$ = The mass of oxygenated species i in dilute exhaust.

M_{OHCi} = The C_1-equivalent molecular weight of oxygenated species i.

m_{dexh} = The mass of diluted exhaust.

$n_{dexhOHCi}$ = The number of moles of oxygenated species i in total diluted exhaust flow.

n_{dexh} = The total diluted exhaust flow.

(b) If we require you to determine NMHCE, use the following equation: